

**Idaho State Department of Agriculture**  
**Nursery Advisory Committee**  
**Final Project Report**

**Title:** Evaluation of Corkbark and Subalpine Fir for Their Potential as Ornamental Nursery Stock and Christmas Trees - 2002 - Grant No. NAC/ISDA 2002-4

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**Introduction:**

This report covers the third year of what is planned as a ten-year study on the growth and development of subalpine and corkbark fir from selected seed sources. Seed sources represented in the collection are listed in Tables 1-3 (each table representing a different site), along with tree heights after two years in seedling styrofoam blocks, 1 year in a nursery transplant bed, and one year in field plantings. Sixty trees of each seed source were kept at the Sandpoint Research & Extension Center (SREC), and the remainder were distributed between Birchhaven Nursery and PossAbilities Tree Farm in Boundary and Bonner County, Idaho, respectively, and Paradise Tree Farm in Enterprise, Oregon. During 2002, survival, 2001 leader growth, total tree heights, and frost damage (Tables 1-3) were measured at the three Idaho plantings. Dates of bud break (Table 4) and trunk diameters (Table 1) were also measured at the SREC.

**Results and Discussion:**

Survival varied between sites and, in some cases, seed sources. Trees at the SREC (irrigated three times during 2001) exhibited the greatest survival, ranging from 92% to 100%, with an overall average of 98%. Most of the mortality at the SREC occurred during early spring of 2002 when the majority of the trees were frost heaved from the silt-loam soil and had to be replanted. Unirrigated trees at PossAbilities Tree Farm exhibited somewhat variable results, with survival ranging from a low of 48% for Santa Fe corkbark to 100% for two other corkbark and one subalpine source. Average survival for all seed sources at PossAbilities was 78%. Survival was poorest at Birchhaven (unirrigated), with complete loss of trees from three seed sources and an overall survival rate of 50%.

Frost damage to newly-opened buds was widespread on all three Idaho sites during the spring of 2002. An average of 64% of subalpine and 66% of corkbark trees had one or more frost-damaged buds. At the SREC, frost damage occurred on May 8-10 when nighttime temperatures dropped to 23°, 25°, and 27°F, respectively. The average dates of bud break (needles from one or more buds on a tree being visible) were remarkably consistent among all of the seed sources and between subalpine and corkbark trees. The first average date of bud break ranged from April 30 through May 4 for subalpine and May 1 through May 4 for corkbark trees. The earliest bud break was noted on April 29 and the latest on May 13. The range in bud break dates for all subalpine sources was 5 days, with an average range of 7 days for corkbark trees. Subalpine fir from the Kaibab National Forest and corkbark fir from the Cocino National Forest showed the greatest range in bud break at 13 days.

At the SREC, Kaibab subalpine trees were most resistant to frost, with an average of 38% of the trees showing frost injury, compared with an average of 77% for all subalpine seed sources. Compared with concolor fir (*Abies concolor*) and Colorado spruce (*Picea pungens*) trees in nearby blocks, subalpine and corkbark trees broke bud earlier. Bud break on concolor trees occurred between about May 10 and May 20 and on Colorado spruce trees between May 17 and May 26. No frost damage was observed on concolor fir or Colorado spruce. It should be noted that the concolor fir and spruce trees were planted in 1996 and approaching harvest size, as opposed to the small subalpine and corkbark fir seedlings. Frost damage was most prominent on the lower, southwestern sides of the trees where heat from the ground encouraged earlier bud break. By the first of July, the corkbark and subalpine fir seedlings at the SREC were exhibiting vigorous growth with earlier frost damage having little impact on the appearance of most trees.

During bud break counts and growth measurements, investigators noted frequent failure of terminal and top whorl lateral buds on subalpine and corkbark fir trees to form leaders. This disorder has been noted by subalpine fir growers in the past, and the cause of the problem remains to be determined. Although lateral buds below the top whorl break and turn upward, the overall growth rates of affected trees are reduced and the lack of a symmetrical central leader reduces their marketability.

The heights of the seedlings varied significantly within and between seed sources. Corkbark seedlings were generally taller than subalpine seedlings after two years in containers. This trend continued after one year in transplant beds and one year in the field. Graphical comparisons of growth rates at the three sites are shown in Figures 1 and 2. In 14 of the 16 seed sources, trees at the SREC were taller than those at the other sites. Dixie and San Isabel subalpine trees were tallest at Birchhaven. Growth rates during 2001 were similar at the SREC and Birchhaven, with subalpine trees growing an average of 2.5-2.6 cm (1.0 inch) and corkbark trees 2.9-3.0 cm (1.2 inch). Trees at PossAbilities developed little leader growth in 2001, averaging 0.4 cm (0.2 inch) for subalpine and 0.3 cm (0.1 inch) for corkbark trees.

**Conclusions:**

Given the young age of the trees and the short observation time to date, only tentative conclusions can be drawn at this time, pending further data. In general, corkbark fir grow more rapidly than subalpine fir when young, producing marketable liner seedlings perhaps one year earlier. While both varieties grow well in cone-shaped nursery containers, their slow root growth (compared with other conifers) may leave the plug-grown seedlings more susceptible to frost heaving than those seeded directly into nursery beds. It would appear prudent to grow plug-grown seedlings in a nursery transplant bed for at least one year, and preferably two years, before lining out in fields. Regardless of variety or seed source, both subalpine and corkbark fir trees break dormancy early, making them susceptible to spring frost damage. Site selection will likely be critical for successful production. Sloped sites having excellent cold air drainage and lying above frost pockets and temperature inversion layers would appear to be highly desirable. Cultural practices significantly impact young subalpine and corkbark fir performance. The higher survival and growth rates at the SREC are likely due, in part, to irrigation. Weed control and, in particular, herbicide selection appear to be important factors. Excellent weed control with no apparent tree damage was achieved at the SREC using registered herbicides at manufacturer-recommended rates.

**Future Plans:**

Provided grant funding continues, survival, frost damage, and growth will be measured annually at the SREC, PossAbilities, and Birchhaven plots. Trunk diameter and the dates of bud break will be measured annually at the SREC. As the trees approach harvest size, needle length, color, and retention after cutting for Christmas trees will be characterized, and the trees will be graded according to standards for Christmas trees and nursery stock. Survival and tree heights at Paradise tree farm will be measured at the time of harvest.

Table 1. Average height, growth, survival, frost damage, and trunk diameters for four-year-old corkbark and subalpine fir seedlings at the University of Idaho Sandpoint R&amp;E Center.

| Seed source<br>(national forest) | Variety   | Height<br><sup>1</sup> (cm) | 2001<br>Growth <sup>2</sup><br>(cm) | Survival<br><sup>3</sup><br>(%) | Frost<br>damage <sup>4</sup><br>(%) | Trunk<br>diameter <sup>5</sup><br>(mm) |
|----------------------------------|-----------|-----------------------------|-------------------------------------|---------------------------------|-------------------------------------|--|
| Arapaho                          | Subalpine | 17.1                        | 1.7                                 | 96.4                            | 91.7                                | 9.7                                    |
| Carson                           | Subalpine | 18.8                        | 2.3                                 | 95.2                            | 86.7                                | 10.9                                   |
| Cibola                           | Subalpine | 17.4                        | 2.3                                 | 95.1                            | 93.3                                | 10.9                                   |
| Dixie                            | Subalpine | 20.2                        | 2.6                                 | 100                             | 55.0                                | 11.1                                   |
| Kaibab                           | Subalpine | 24.4                        | 3.3                                 | 98.1                            | 38.3                                | 11.2                                   |
| Manti-LaSal                      | Subalpine | 19.8                        | 2.4                                 | 100                             | 71.7                                | 10.1                                   |
| Rio Grande                       | Subalpine | 17.7                        | 2.8                                 | 97.5                            | 96.7                                | 10.1                                   |
| San Isabel                       | Subalpine | 15.9                        | 2.4                                 | 100                             | 88.3                                | 10.5                                   |
| San Juan                         | Subalpine | 19.1                        | 3.5                                 | 100                             | 98.3                                | 10.8                                   |
| Uncompahgre                      | Subalpine | 21.8                        | 3.1                                 | 99.1                            | 48.3                                | 10.7                                   |
| Subalpine average                |           | 19.2                        | 2.6                                 | 98.1                            | 76.8                                | 10.6                                   |
| Apache-Sitgreaves                | Corkbark  | 29.4                        | 3.9                                 | 100                             | 53.3                                | 11.9                                   |
| Cibola                           | Corkbark  | 24.2                        | 3.1                                 | 100                             | 60.0                                | 11.7                                   |
| Cocino                           | Corkbark  | 21.1                        | 2.3                                 | 100                             | 66.7                                | 10.7                                   |
| Coronado                         | Corkbark  | 23.2                        | 2.9                                 | 100                             | 75.0                                | 10.8                                   |
| Gila                             | Corkbark  | 28.2                        | 2.1                                 | 99.2                            | 81.7                                | 11.5                                   |
| Santa Fe                         | Corkbark  | 23.1                        | 2.9                                 | 91.7                            | 56.7                                | 12.5                                   |
| Corkbark average                 |           | 24.9                        | 2.9                                 | 98.5                            | 65.6                                | 11.5                                   |

1. height = average height from the ground to the topmost tip of the leader
2. 2001 growth = average length of leader formed during 2001
3. survival = percentage of trees alive in June 2002
4. frost damage = percentage of trees having one or more frost-damaged buds
5. trunk diameter = average trunk diameter, measured at 5 cm (2 inches) above the ground

Table 2. Average height, growth, survival, frost damage, and trunk diameters for four-year-old corkbark and subalpine fir seedlings at PossAbilities Tree Farm.

| Seed source<br>(national forest) | Variety   | Height<br><sup>1</sup> (cm) | 2001 Growth <sup>2</sup><br>(cm) | Survival <sup>3</sup><br>(%) | Frost damage <sup>4</sup><br>(%) |
|----------------------------------|-----------|-----------------------------|----------------------------------|------------------------------|----------------------------------|
| Arapaho                          | Subalpine | 11.1                        | 0.5                              | 74.4                         | 53.9                             |
| Carson                           | Subalpine | 14.8                        | 1.2                              | 57.6                         | 45.5                             |
| Cibola                           | Subalpine | 13.1                        | 0.3                              | 72.3                         | 38.9                             |
| Dixie                            | Subalpine | 15.2                        | 0.0                              | 75.9                         | 31.0                             |
| Kaibab                           | Subalpine | 17.3                        | 0.4                              | 87.8                         | 59.2                             |
| Manti-LaSal                      | Subalpine | 13.6                        | 0.6                              | 96.4                         | 71.4                             |
| Rio Grande                       | Subalpine | 11.8                        | 0.2                              | 86.7                         | 73.3                             |
| San Juan                         | Subalpine | 13.0                        | 0.7                              | 100                          | 80.0                             |
| Uncompahgre                      | Subalpine | 18.5                        | -0.4                             | 96.0                         | 52.0                             |
| Subalpine average                |           | 12.8                        | 0.4                              | 74.7                         | 50.5                             |
| Apache-Sitgreaves                | Corkbark  | 24.0                        | 0.7                              | 100                          | 94.7                             |
| Cibola                           | Corkbark  | 21.6                        | 0.1                              | 95.0                         | 70.0                             |
| Cocino                           | Corkbark  | 16.3                        | 0.6                              | 68.7                         | 59.4                             |
| Coronado                         | Corkbark  | 20.7                        | 0.5                              | 100                          | 76.9                             |
| Gila                             | Corkbark  | 25.0                        | -0.1                             | 94.4                         | 77.8                             |

|  |          |      |     |      |      |
|--|----------|------|-----|------|------|
| Santa Fe   | Corkbark | 19.2 | 0.2 | 48.4 | 33.9 |
| Corkbark average   |          | 21.1 | 0.3 | 84.4 | 68.8 |
| <p>1. height = average height from the ground to the topmost tip of the leader<br/>2. 2001 growth = average length of leader formed during 2001<br/>3. survival = percentage of trees alive in June 2002<br/>4. frost damage = percentage of trees having one or more frost-damaged buds</p> |          |      |     |      |      |

Table 3. Average height, growth, survival, frost damage for four-year-old corkbark and subalpine fir seedlings at Birchhaven Nursery.

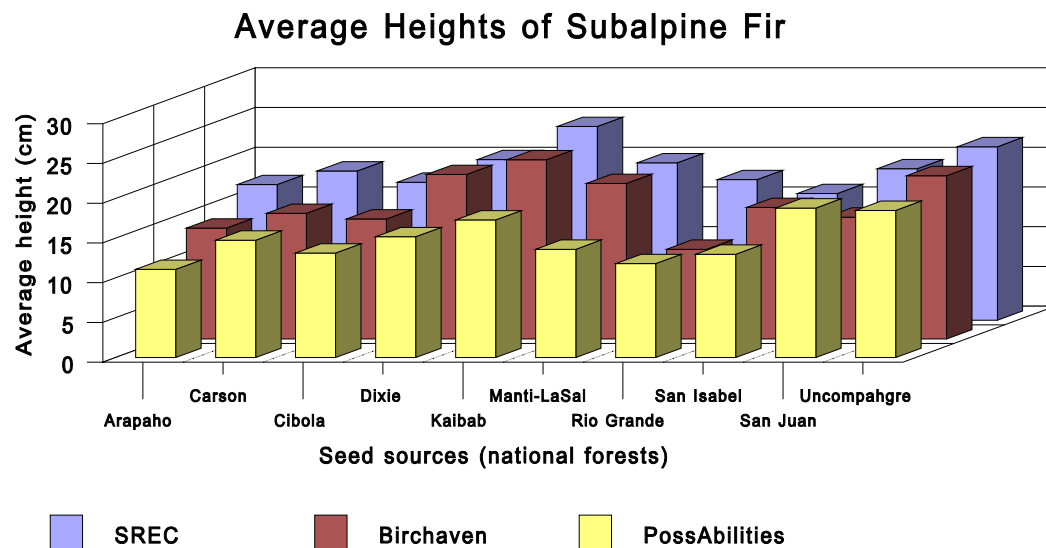
| Seed source<br>(national forest) | Variety   | Height <sup>1</sup><br>(cm) | 2001<br>Growth <sup>2</sup><br>(cm) | Survival <sup>3</sup><br>(%) | Frost damage <sup>4</sup><br>(%) |
|----------------------------------|-----------|-----------------------------|-------------------------------------|------------------------------|----------------------------------|
| Arapaho                          | Subalpine | 13.9                        | 2.1                                 | 74.4                         | 82.8                             |
| Carson                           | Subalpine | 15.8                        | 1.9                                 | 21.2                         | 71.4                             |
| Cibola                           | Subalpine | 15.1                        | 3.1                                 | 70.4                         | 57.9                             |
| Dixie                            | Subalpine | 20.7                        | 2.3                                 | 100                          | 66.7                             |
| Kaibab                           | Subalpine | 22.5                        | 2.6                                 | 91.7                         | 65.9                             |
| Manti-LaSal                      | Subalpine | 19.6                        | 5.0                                 | 63.0                         | 64.7                             |
| Rio Grande                       | Subalpine | 11.3                        | 1.0                                 | 10.0                         | 0.0                              |
| San Isabel                       | Subalpine | 16.5                        | 2.0                                 | 91.7                         | 72.7                             |
| San Juan                         | Subalpine | 15.3                        | 2.3                                 | 90.5                         | 94.7                             |
| Uncompahgre                      | Subalpine | 20.5                        | 2.4                                 | 74.1                         | 55.0                             |
| Subalpine average                |           | 17.1                        | 2.5                                 | 68.7                         | 63.2                             |
| Apache-Sitgreaves                | Corkbark  | 25.5                        | 3.2                                 | 7.1                          | 100                              |
| Cibola                           | Corkbark  | 20.1                        | 2.5                                 | 34.4                         | 36.4                             |
| Cocino                           | Corkbark  | ---                         | ---                                 | 0.0                          | ---                              |
| Coronado                         | Corkbark  | ---                         | ---                                 | 0.0                          | ---                              |
| Gila                             | Corkbark  | ---                         | ---                                 | 0.0                          | ---                              |
| Santa Fe                         | Corkbark  | 21.0                        | 3.4                                 | 66.7                         | 57.5                             |
| Corkbark average                 |           | 22.2                        | 3.0                                 | 36.1                         | 64.6                             |



1. height = average height from the ground to the topmost tip of the leader
2. 2001 growth = average length of leader formed during 2001
3. survival = percentage of trees alive in June 2002
4. frost damage = percentage of trees having one or more frost-damaged buds

Table 4. 2002 bud break data taken at the University of Idaho Sandpoint R&amp;E Center.

| Seed source<br>(national forest) | Variety   | Dates of bud break |        | Range of bud<br>break dates<br>(days) | Average<br>bud break<br>date |
|----------------------------------|-----------|--------------------|--------|---------------------------------------|------------------------------|
|                                  |           | Earliest           | Latest |                                       |                              |
| Arapaho                          | Subalpine | May 1              | May 6  | 6                                     | May 2                        |
| Carson                           | Subalpine | April 29           | May 3  | 5                                     | April 30                     |
| Cibola                           | Subalpine | April 29           | May 3  | 5                                     | May 1                        |
| Dixie                            | Subalpine | May 1              | May 3  | 3                                     | May 1                        |
| Kaibab                           | Subalpine | May 1              | May 13 | 13                                    | May 4                        |
| Manti-LaSal                      | Subalpine | April 29           | May 3  | 5                                     | May 1                        |
| Rio Grande                       | Subalpine | April 29           | May 3  | 5                                     | May 1                        |
| San Isabel                       | Subalpine | April 29           | May 1  | 3                                     | April 30                     |
| San Juan                         | Subalpine | May 1              | May 3  | 3                                     | May 1                        |
| Uncompahgre                      | Subalpine | May 1              | May 6  | 6                                     | May 2                        |
| Subalpine average                |           | April 30           | May 4  | 5.4                                   | May 1                        |
| Apache-Sitgreaves                | Corkbark  | May 1              | May 8  | 8                                     | May 3                        |
| Cibola                           | Corkbark  | May 1              | May 8  | 8                                     | May 2                        |
| Cocino                           | Corkbark  | May 1              | May 13 | 13                                    | May 4                        |
| Coronado                         | Corkbark  | May 1              | May 6  | 6                                     | May 2                        |



|                  |          |       |       |     |       |
|------------------|----------|-------|-------|-----|-------|
| Gila             | Corkbark | May 1 | May 3 | 3   | May 1 |
| Santa Fe         | Corkbark | May 1 | May 6 | 6   | May 2 |
| Corkbark average |          | May 1 | May 7 | 7.3 | May 2 |

Figure 1. Heights of subalpine fir seedlings after 2 years in containers, 1 year in transplant beds, and 1 year in field plantings at the University of Idaho Sandpoint Research & Extension Center (SREC), Birchhaven Nursery, and PossAbilities Tree Farm.

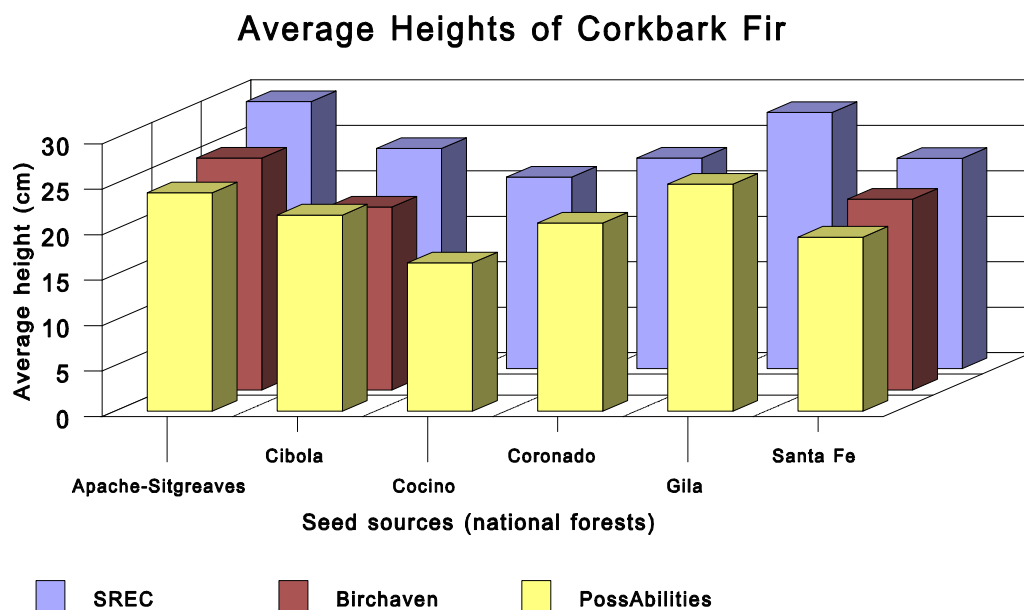


Figure 2. Heights of corkbark fir seedlings after 2 years in containers, 1 year in transplant beds, and 1 year in field plantings at the University of Idaho Sandpoint Research & Extension Center (SREC), Birchhaven Nursery, and PossAbilities Tree Farm.